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# EXCESSIVE STOCKING

AND

# RULE-OF-THUMB MANAGEMENT

FROM

THE WESTERN RANGE—A GREAT  
BUT NEGLECTED NATURAL RESOURCE

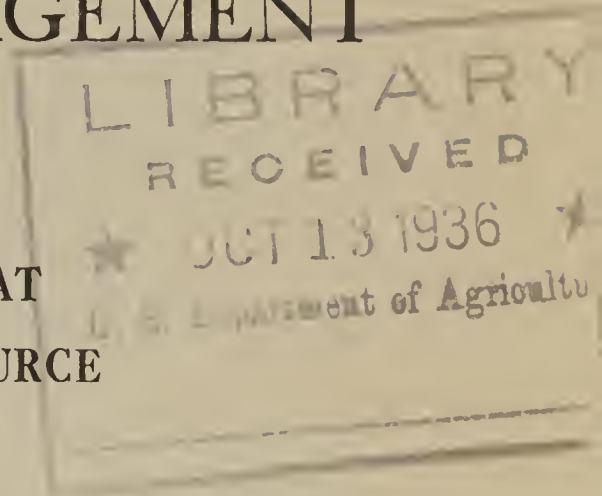
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## EXCESSIVE STOCKING

By W. R. CHAPLINE, Chief, Division of Range Research

"The Last of 5,000", that graphic sketch by Charles Russell, world-famous Montana cowboy artist, depicts strikingly the ultimate effect of excessive stocking. One feels that the poor, lone "critter", so utterly emaciated and filled with despair, will soon be a feast for the coyotes lurking in the background. Granville Stuart, in his *Forty Years on the Frontier* (138), writes:

Charlie was in charge of a herd in the Judith Basin, when the owner, who lived in Helena, wrote and asked how his cattle was getting along. For answer Charlie sent him the sketch.

The important cause, Stuart indicates, was range depletion, brought about by overstocking. He describes how, during the summer of 1885, more than 100,000 head of cattle and innumerable bands of sheep trailed into Montana onto an already crowded range. Then came the first heavy losses from the eating of poisonous plants, in the spring of 1886, because of the shortage of palatable forage. Again that summer, more stock poured into Montana; it was hot and dry, and a severe winter followed. "The cows were all thin" and losses were extremely heavy. Some herds—

perished outright. Others lost from 75 to 80 percent of their cattle. \* \* \* In the spring of 1887 the ranges presented a tragic aspect. Along the streams and in the coulees everywhere were strewn the carcasses of dead cattle. Those that were left alive were poor and ragged in appearance, weak, and easily mired in the mudholes.

This may seem an extreme situation, but many like it were recorded in early historical accounts. Bentley (16), for example, in explaining the tendency to expand the cattle business in western Texas, states:

As a result of this madness, the range was overstocked, and a dozen cows and sheep were crowded on the "free grass", where half the number was too many. The ranges were quickly eaten and trampled out. \* \* \*

One cowman decided to sell his herd of 25,000 cattle in 1882:

He did not get his price, hence had to hold over his herd through the winter of 1882-83. It was an exceptionally severe one, and the following spring only about 10,000 head were rounded up. \* \* \* On the 100,000 acres he was using he might have held 10,000 head of cattle safely, \* \* \* but in his eagerness to get rich fast he greatly overstocked the range, made no provision for winter feed, never thought it necessary to provide any sort of shelter for his stock, and suffered the inevitable consequences of this reckless way of doing business.

Gordon (58), in a special report on the range area accompanying the Tenth Census in 1880 considered some ranges overstocked and depleted even then. He referred to these conditions in such statements as the following:

The best quality of pasture of today (in Colorado) is only comparatively good, the best quality of 20 years ago having been essentially changed. \* \* \* The character of the natural grazing in southwest Montana has greatly depreciated. Stockmen of the longest experience reported that a cow ranged 50



acres to find what grew on 20 acres 6 years ago, and on 5 acres in 1870. \* \* \* "Free range" \* \* \* resulted in excessive grazing, and rendered many wide areas of Nevada south of the Humboldt River wholly unfit for more than a limited stock occupancy.

Thornber (144), in describing the early situation in Arizona, stated:

The serious consequences attending the grazing, ultimately, of nearly double the number of stock on the ranges that could be carried safely year after year, culminated in the disastrous droughty period of 1891 to 1894. \* \* \* With a general shortage of feed and water on the ranges, stock died off on every hand. It is estimated that over 250,000 cattle, out of somewhat more than 800,000 all told, perished on the ranges in Arizona alone during the period of 1891 to 1894, not to mention the number of sheep and other grazing animals. In many localities from 25 to 50 percent of the stock died from starvation, while as many more were left in such condition as to require a season for recovery.

President Theodore Roosevelt's commission to study the land situation and to make recommendations for the best utilization of the remaining public domain, after an exhaustive study including 1,400 answers to a circular letter addressed to stockmen throughout the West, reported in 1905 (146), in effect, that the general lack of control of the range lands had resulted in overgrazing and in the ruin of millions of acres of otherwise valuable grazing territory.

There can be little question but that these writers and the Roosevelt Commission were convinced that during the eighties, nineties, and early 1900's, ranges were excessively stocked and were being depleted as a result.

The range wars of these early days were still another symptom of overstocking. Had range feed been sufficiently abundant to meet the needs of all the livestock that new settlers and stockmen aspired to graze, little reason for conflict would have developed. However, when the established stockmen witnessed the invasion of "trespassing" herds and saw their winter's feed supply vanishing, as hungry animals consumed every vestige of forage, deadly strife resulted.

Has excessive stocking, the grazing of more livestock or other animals on a range in any year than the available range feed can sustain year in and year out, continued on range lands, and has it caused range deterioration? Some stockmen and others are not convinced that it has. The serious and widespread depletion of range lands has already been pointed out. If excessive stocking has been responsible, at least in part, and if present stocking constitutes overstocking, there should be evidence to prove it.

#### EVIDENCES OF EXCESSIVE STOCKING

Evidences of excessive stocking include such features as:

(1) The inability of the range to support the large numbers of livestock carried since about 1890 within the range area, indicated in two ways—by an increasing use of feeds other than range forage, and by a declining trend in numbers of livestock grazing range lands.

(2) Deterioration of the range itself, which is not alone due to climate.

(3) Present stocking considerably in excess of estimated grazing capacity.

(4) Serious losses and other unsatisfactory production as a result of range feed shortage.



## NUMBERS OF LIVESTOCK WITHIN RANGE AREA

In order to get at the evidences of excessive stocking, it is necessary to consider first the numbers of livestock which have been carried within the range area.

The approximate numbers of livestock,<sup>11</sup> expressed in animal units,<sup>12</sup> from 1870 to 1935, within the 11 far-western States and the range portion of the six Plains States, are shown graphically in figure 52.

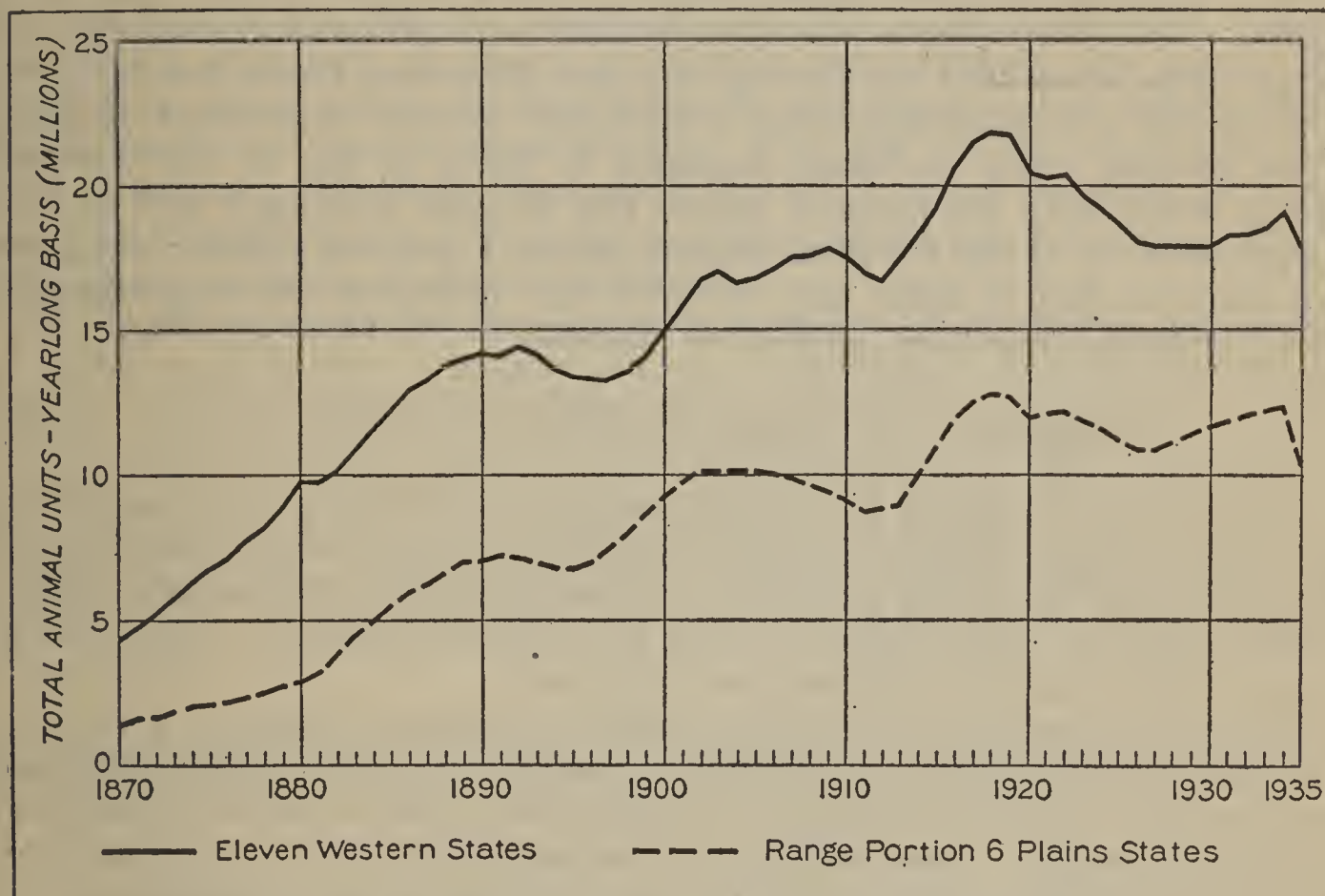


FIGURE 52.—Trends in total animal units in the range country.

Even in the face of severe losses in critical periods, numbers of livestock show a rising trend for the first 48 years. Starvation and winter losses of the eighties were soon forgotten; those stockmen who still had a remnant on which to build and new settlers with capital brought in from the East forced numbers on upward. Livestock were pushed back into the less accessible mountain ranges and into the poorly watered desert areas. The depression, drought, and lack of range feed of the early nineties again took their toll and halted the upward trend for a few years, but another upward surge, principally in sheep, brought a new high peak about 1903.

A still higher peak was reached in 1918, the result of the World War urge for increased production and the encouragement of high

<sup>11</sup> The yearly estimates of numbers of livestock in the range area are derived from the published revised estimates of the Bureau of Agricultural Economics for the 17 Western States for January of each year from 1919 to 1935, and before that time, from unpublished revisions by that Bureau where available, and other similar revisions based on original published estimates of the Department of Agriculture and Census records. For the range portion of the six Plains States, the January 1 estimates for census years were determined by using a proportionate ratio of census numbers in counties in the range area to that for the whole State. Although these numbers cannot be considered as accurate for all years, they do show with reasonable accuracy the main trends for the period under consideration.

<sup>12</sup> An animal unit for purposes of this report is considered to be one head of cattle, one horse, one mule, five sheep, five swine, or five goats. The ratio of five to one was considered a suitable average of the generally lower ratio between cattle and sheep on the range, which in places is found by the Forest Service to be as low as three to one, and the higher ratio between cattle and sheep in the feed lot used by animal husbandmen.



prices and easy credit. At that time there were approximately 13,254,000 cattle, 22,457,000 sheep, 3,347,000 horses and mules, and 3,565,000 swine and goats in the 11 far-western States. At the same time, in the range portion of the six Plains States there were approximately 8,082,000 cattle, 1,478,000 sheep, 2,837,000 horses and mules, and 5,276,000 swine and goats. Since the war there has been a declining trend in livestock numbers with an abrupt drop in 1934.

Total number of animals within the range area is not an entirely reliable criterion of overstocking since it does not tell the whole story. Numbers which have grazed on the range is the important point. Those who have considered that, because numbers within the range area have held up during the last 35 years, there has been no widespread overstocking, have overlooked several important factors. True, animal units on hand January 1, 1935, in the 11 far-western States were only 4.4 percent below the 35-year average; and in the range portion of the 6 Plains States, about 7 percent below; but such calculations fail to take into account the influence of supplemental feed, irrigated pastures, and other factors.

#### NUMBERS OF LIVESTOCK ON RANGE AND OTHER FEED

In the early days of the West nearly all livestock obtained their feed from range forage. A few ranches put up a small quantity of hay, but this was used primarily for maintaining the saddle horses rather than as supplemental feed for other livestock, except when deep snows or other emergencies required.

When the pressure for range became acute the cattlemen, who were the first to feel it, not only began to practice winter feeding but also to purchase ranch properties on which they could produce hay and other roughages. Later, sheepmen in turn were forced to take similar action (166). The bringing into permanent crop production of about 100 million acres in the West cut into the more desirable range areas but made available large quantities of supplemental feeds and also much stubble for grazing.

In 1890 there was only 34,687,000 acres of improved farm land of all kinds in the range area, with a little over 3,600,000 acres irrigated; improved pastures were not abundant, and there was relatively little shipment of concentrates into the range country. By 1930 the cultivated area was nearly three times as great as all improved land in farms in 1890; hay and other forage-crop production was nearly five times as great; irrigated land had also increased fivefold; improved pastures were common on farms, and millions of acres of wheat and other grain stubble were used for grazing. Several million tons of grain, cottonseed cake, linseed meal, and other concentrates are now produced or shipped into the range area for feeding. Other products used for feeding have also become of vast importance, such as ensilage, beet pulp, pea vines, bean straw, fish meal, and rice and fruit byproducts.

While part of this feed has been used to safeguard against losses from inclement weather and because of changed production practices in the livestock industry, much of it has had to be used because of increasing scarcity and lower value of range forage, manifest in longer winter feeding periods and increased need for supplements at other times.



Numerous examples might be cited from all sections of the West of longer winter feeding periods because of scarcity of range feed. Cattle are now fed hay and other roughages often for 3 to 5 months, whereas in the early days such feeds were seldom required for more than a month or so and that commonly as a supplement to winter grazing.

Similarly the loss of highly palatable forage plants from the range and the necessity of livestock subsisting on low-value plants has required use of concentrates to furnish the protein and vitamin A (69) so essential to the well-being of the animals. Thousands of tons of cottonseed cake, for example, are fed on southwestern ranges and many carloads of grain and other concentrates are hauled to ranges in other parts of the West to supplement the low-quality range feed now generally available. The use of this supplemental feed, however, has made it possible to carry large numbers of livestock on ranges where they subsist primarily on the low-value plants and thus overgraze the more palatable.

Table 27 presents the approximate number of livestock, expressed in animal units per year grazed on range lands, including unirrigated farm pastures and stubble fields, and the approximate number which obtained feed from harvested crops, concentrates, and other supplements,<sup>13</sup> and from irrigated pastures<sup>14</sup> from 1870 to 1935. It is believed that the improved unirrigated farm pastures, grain stubble, and unrecorded concentrates shipped into the range area will offset the 11 percent decline in range area which has occurred, chiefly since 1890.

TABLE 27.—*Animal units dependent on range feed and on supplemental feed and irrigated pastures, in the 11 far-western States and the 6 Plains States, 1870-1935*

[In thousands of animal units]

| Region and type of feed           | 1870   | 1880    | 1890    | 1900    | 1910    | 1920    | 1930    | 1935    |
|-----------------------------------|--------|---------|---------|---------|---------|---------|---------|---------|
| 11 far-western States:            |        |         |         |         |         |         |         |         |
| On range <sup>1</sup> .....       | 4, 229 | 9, 214  | 12, 523 | 11, 406 | 10, 449 | 11, 190 | 10, 699 | 10, 032 |
| On other feed <sup>2</sup> .....  | 204    | 582     | 1, 676  | 3, 399  | 7, 091  | 9, 274  | 7, 261  | 7, 545  |
| Total.....                        | 4, 433 | 9, 796  | 14, 204 | 14, 805 | 17, 540 | 20, 454 | 17, 960 | 17, 577 |
| Range portion of 6 Plains States: |        |         |         |         |         |         |         |         |
| On range <sup>1</sup> .....       | 1, 390 | 2, 807  | 6, 753  | 8, 504  | 7, 630  | 9, 541  | 9, 293  | 7, 260  |
| On other feed <sup>2</sup> .....  | 45     | 130     | 375     | 792     | 1, 521  | 2, 541  | 2, 414  | 2, 935  |
| Total.....                        | 1, 435 | 2, 937  | 7, 133  | 9, 296  | 9, 151  | 12, 082 | 11, 707 | 10, 195 |
| Total range area:                 |        |         |         |         |         |         |         |         |
| On range <sup>1</sup> .....       | 5, 619 | 12, 021 | 19, 286 | 19, 910 | 18, 079 | 20, 721 | 19, 992 | 17, 292 |
| On other feed <sup>2</sup> .....  | 249    | 712     | 2, 051  | 4, 191  | 8, 612  | 11, 815 | 9, 675  | 10, 480 |
| Total.....                        | 5, 868 | 12, 733 | 21, 337 | 24, 101 | 26, 691 | 32, 536 | 29, 667 | 27, 772 |

<sup>1</sup> Including improved unirrigated farm pastures.

<sup>2</sup> Harvested crops, concentrates, and irrigated pastures.

<sup>13</sup> The approximate number which obtained feed from harvested crops and other concentrates was derived for each census year by relating the number of livestock obtaining feed from harvested crops and concentrates in 1925, as worked out by the committee of the U. S. Department of Agriculture (Feed Resources: 11 Western States. Ext. Ser. Circ. 41, 23 pp., illus., 1927, mimeographed), to the census record of hay and forage crop production in 1925, and then using that same index in relation to hay and other forage production as shown by the census in the other census years. The average production of recent years was used in 1935 rather than the short feed production in 1934. In the main this method is comparable to considering approximately 2 tons of cottonseed products, 2¾ tons of grain and other concentrates, or approximately 7 tons of hay and fodder per animal unit per year. These figures are more conservative than are sometimes used in determining feed requirements in the range area.

<sup>14</sup> Two acres of irrigated pasture is considered necessary per animal unit per year.



## DECLINING NUMBERS ON RANGE THROUGHOUT THE WEST INDICATE EXCESS

In the range portion of the Plains States, numbers on ranges reached an early peak of over 8.5 million animal units about 1900. After a decline of around 10 percent to 1910 a new peak was established about 1920 when approximately 9.5 million animal units were on these range lands. Since 1920 there has been a decline of about 24 percent, especially marked in 1934. These figures may not be an entirely true picture of range stocking in the Plains States because of a number of uncertain factors. There are, for example, large quantities of unrecorded grain and other feeds shipped into this area, an unestimated area of grain fields that are grazed in winter and as stubble, and some of the cattle recorded as on farms and ranges on January 1 are shipped out of the area in the spring. The difficulty of taking adequate account of these features in the Plains States tends to show larger numbers of livestock on ranges throughout the year than is probably the case.

In the 11 far-western States the peak of livestock on ranges was reached about 1890, when 12.5 million animal units were obtaining their feed from range lands, 88 percent of the livestock then in these States. By 1910, around 10.4 million animal units were on range, about 60 percent of the total animal units. Following another rise to 1920 there has been a declining trend to 1935 when about 10 million, 57 percent of the total animal units, were on range lands. Thus a net decline of about 20 percent has occurred on range lands since 1890.

Figure 53 brings out the decline which occurred in the stocking of range lands between 1890 and 1910, and again between 1920 and 1935. While the grazing of heavier animals, as a result of better breeding and other improved animal production practices, may account in part for these declines, they are also undoubtedly due partly to a declining range-feed supply caused by overstocking.

The rise from 1910 to 1920 represents primarily the increase caused by war demands and does not indicate that there was range forage available for the excess livestock. In fact there are many indications that excessive stocking became the rule. In western Texas, for example, the upward trend was abruptly halted in 1916 and 1917 when range conditions failed, starvation losses were widespread, and forced shipments of livestock were made as ranges became more depleted. Along the Texas & Pacific Railroad in the Trans-Pecos country, ranges presented a pitiful sight. Feed gone, carcasses of cattle in great numbers around water holes, and gaunt, stary-eyed cattle still alive, their ribs all but protruding through the flesh—all these evidences told a tragic story of failure to keep numbers within safe limits of range-feed production.

The opening up of new areas by water developments, trails, and other means, has also been a factor in holding up livestock numbers grazing range lands. At first the more readily accessible ranges were stocked. As high prices stimulated expansion or as exhausted feed supplies, especially during drought, compelled removal of livestock from overgrazed ranges, stockmen have drilled wells, constructed reservoirs, and made other improvements in order to utilize formerly unused or lightly used ranges. Such improvements expanded the range livestock industry to the point of compensating



for livestock decreases necessary on many overstocked and deteriorating ranges.

Even the decline from 1890 to 1935 does not in itself indicate that range feed would satisfactorily support the reduced numbers now grazing on ranges. Many herds are being carried on little more than a subsistence basis, aided by the feeding of concentrates. Under such conditions of excessive stocking, cattle, sheep, and especially goats, have continued to graze ranges after all palatable feed had been consumed. It has been necessary for the livestock to subsist almost entirely upon low-value plants such as the common sagebrush.

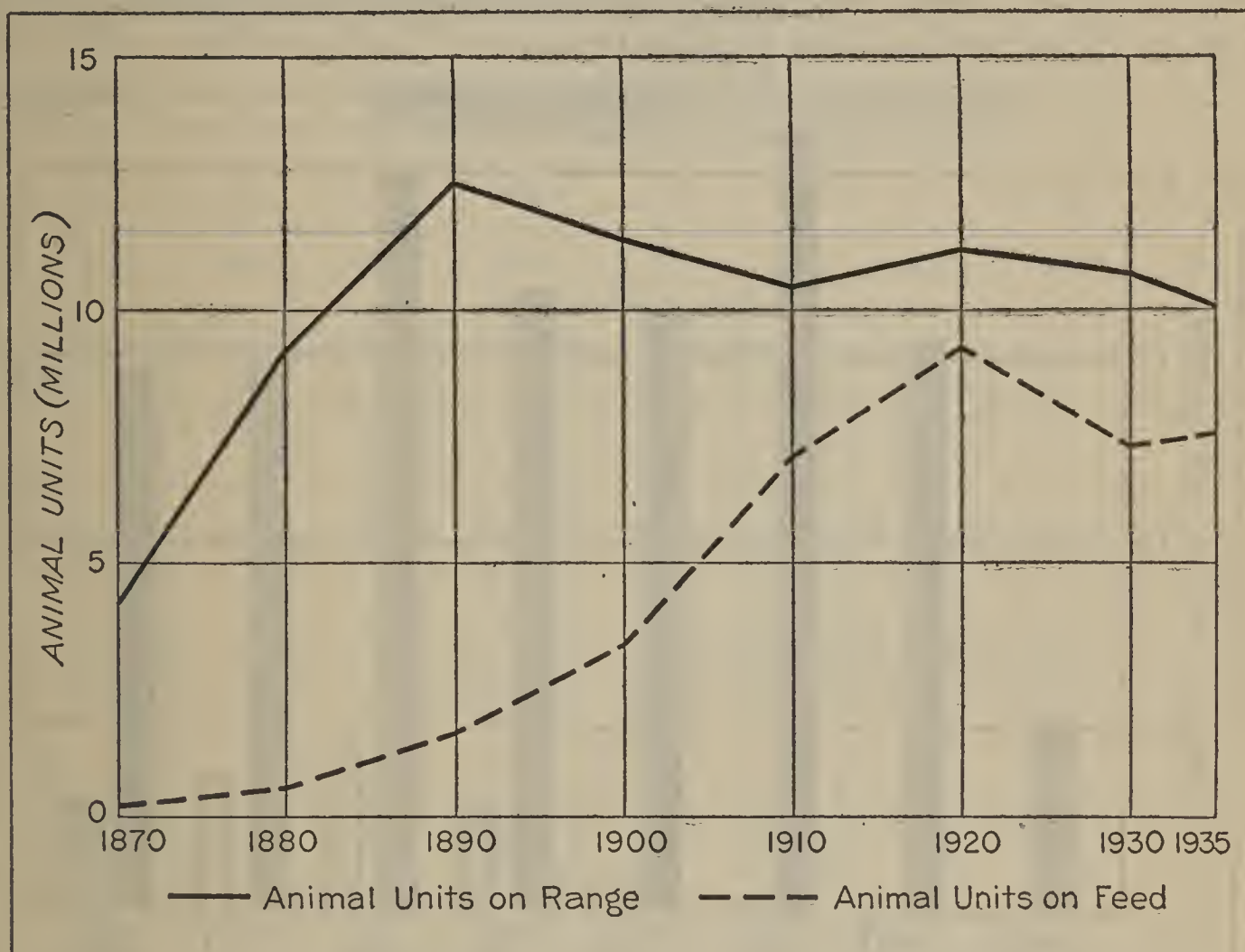


FIGURE 53.—RANGE VERSUS OTHER FEED IN THE FAR-WESTERN STATES.

Despite rapid stocking of range lands between 1870 and 1890, the declining trends in animal units on range from 1890 to 1910 and 1920 to 1935, indicate at least in part depletion of range due to overstocking. This indication is substantiated by the increasing use of expensive supplemental feed.

yellow brush, and weeds, which under conservative utilization would be grazed, but little except possibly in dry years.

The striking increase in livestock carried on feeds other than range forage shown in figure 53 is in itself an evidence of overstocking. Stockmen do not feed hay, costing \$5 to \$20 or more a ton, or costly concentrates, if adequate range pasturage worth \$1 to \$3 and often less for an equal feeding period is available. Winter feeding is expensive and ranchers are now compelled to rely largely on the cheap summer forage for profit.

#### VARIATION IN THE INDIVIDUAL STATES

The situation in the 11 far-western States as a whole is duplicated to a degree in most of the individual States. New Mexico, for example, illustrates an even more marked decline in numbers of live-



stock with declining grazing capacity of range lands and increasing numbers on supplemental feed (fig. 54). In 1890 approximately 2.1 million animal units were grazing range lands, and according to historical and other evidences serious damage was being done to ranges at that time. Both in 1900 and 1910 there were approximately 1.6 million animal units on the range. It is possible that with these lower numbers there were favorable years when the ranges of the State as a whole were not materially overstocked. But, by 1920, war demands had again increased numbers on ranges to more than 2 million animal units and the evidence is ample that ranges throughout the State were then seriously overstocked. In 1924 many cattle had to be moved into old Mexico because of feed shortage. By 1930

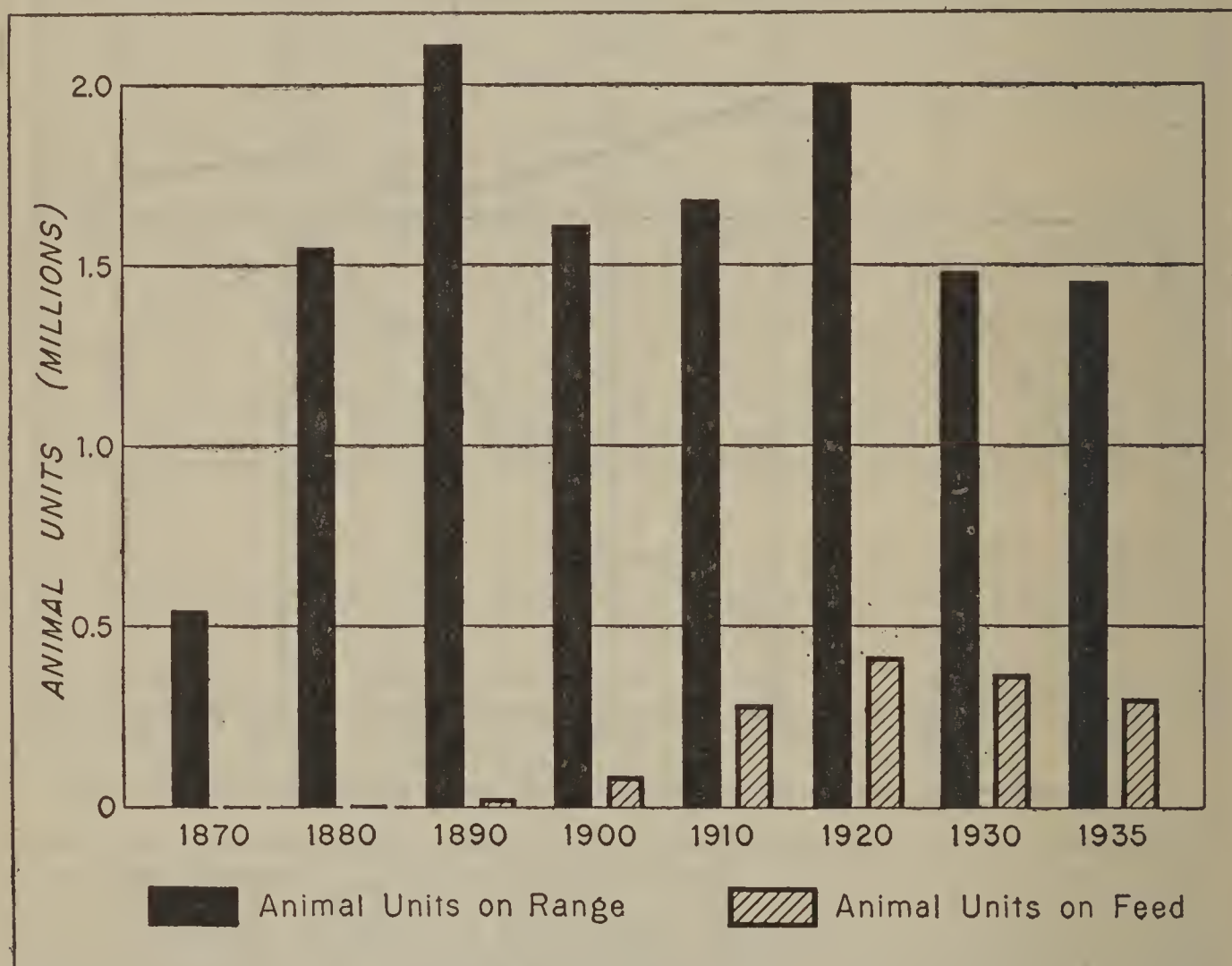


FIGURE 54.—In New Mexico, a State in which livestock depend principally upon range, a decided downward trend in range forage supply since 1890 is indicated.

numbers on ranges had dropped to about 1.5 million animal units, a decline of about 25 percent in 10 years and approximately this same number is grazing range lands in 1935.

In Utah, too, there has been a declining tendency in numbers of livestock grazing range lands since 1900. The increases as a result of war demand were not so great as in New Mexico and some other States. Increased feed has been an important factor in maintaining livestock in the State as a whole. In all, range lands and unirrigated pastures were furnishing only about 45 percent of the feed for livestock in 1935, in contrast to about 77 percent in 1900, as shown in figure 55.

In contrast to declining trends in most other range areas where depletion has resulted from overgrazing, the 33 counties in the range

portion of western Nebraska have carried increasing numbers of livestock on range up through 1930 (fig. 56). These counties are made up primarily of the sand-hill tall-grass prairie type and native hay meadows, which up to 1934 showed little if any deteriora-

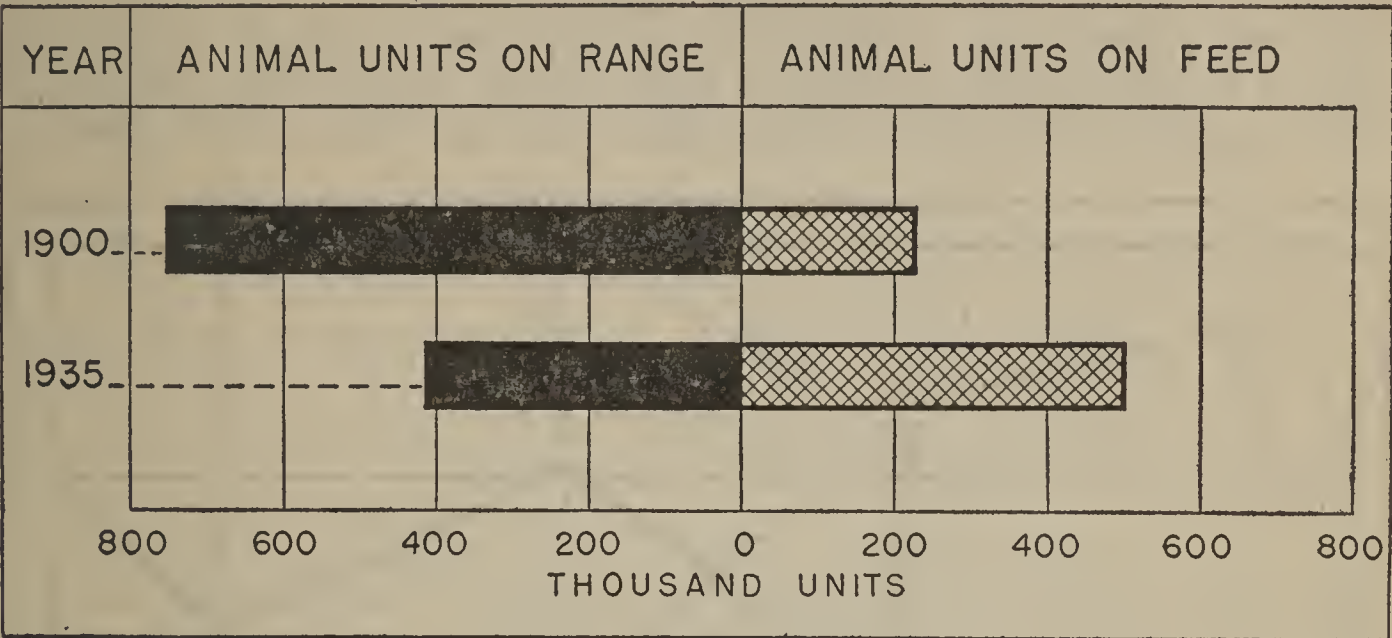


FIGURE 55.—In Utah the animals on feed have more than doubled since 1900, and animal units on range have decreased in still greater numbers.

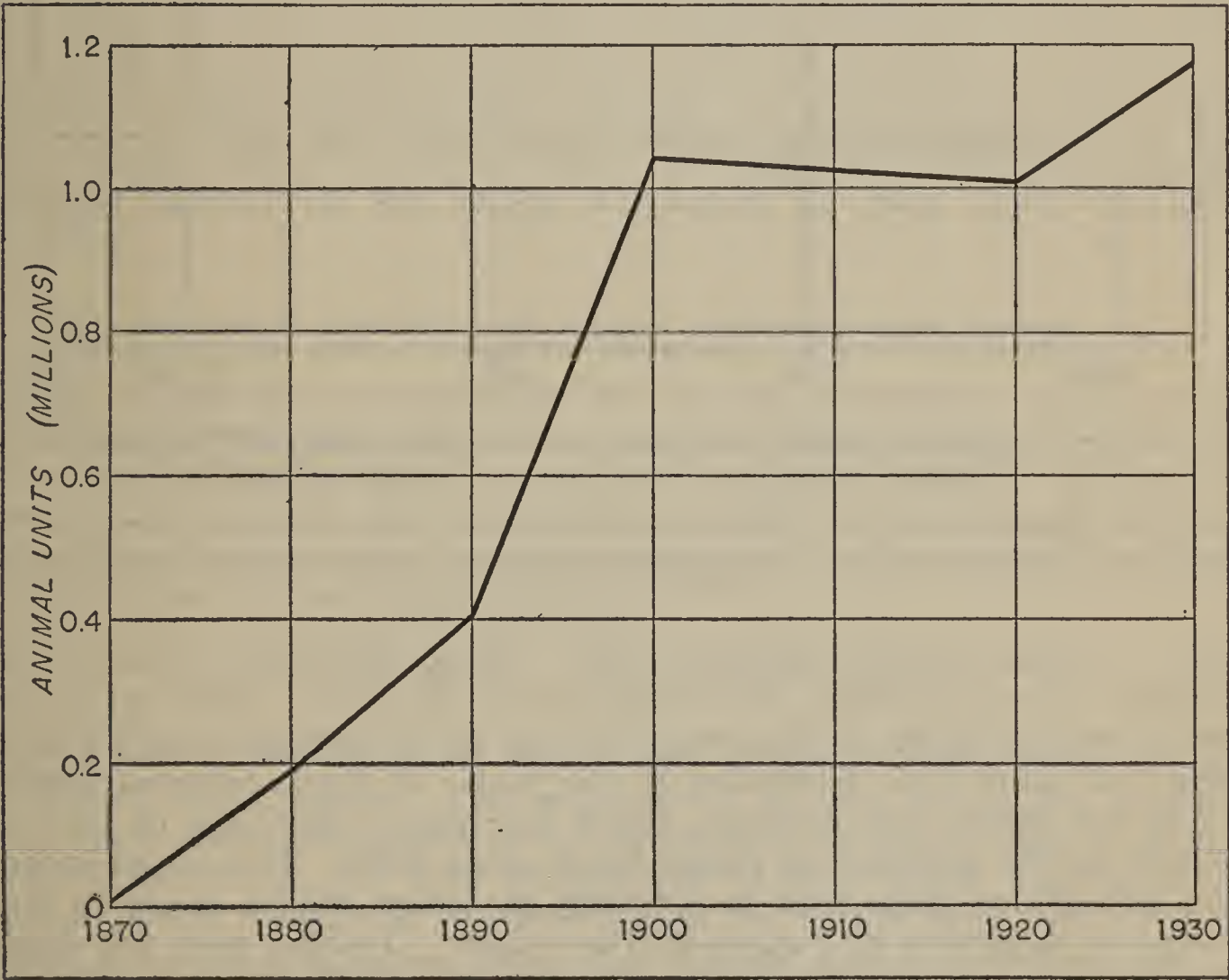


FIGURE 56.—Livestock obtaining feed from range lands in western Nebraska show an upward trend; care of the range on approximately 12,000,000 acres of sand-hill country, which constitutes the bulk of the range in this State, has made this possible.

tion in forage production. In the sand-hill area, in fact, there appears to have been an improvement in forage conditions during the last 50 years as a result of control of prairie fires and conservative grazing.



## RANGE COUNTIES SHOW MARKED DECLINES

When one considers numbers of livestock within most of the counties primarily made up of range land, the effect of overstocking in causing decline in numbers over the years becomes quite marked. Owyhee County, Idaho, furnishes a good example. If we may take historical records and statements of old-time stockmen as a basis, there is a rather clear indication that in 1888 some 100,000 cattle and horses grazed yearlong in the county and at least 50,000 sheep, a

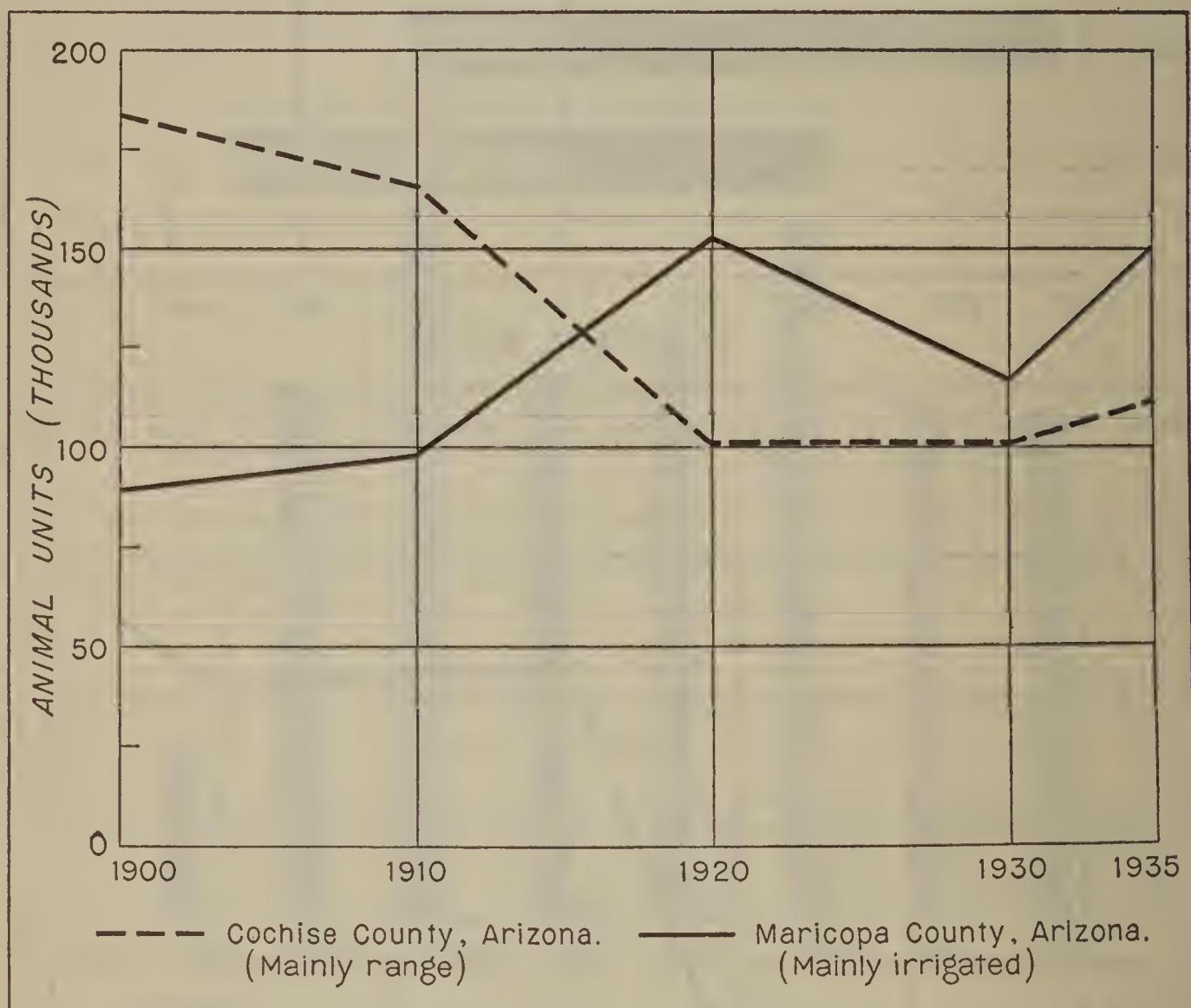


FIGURE 57.—Striking contrast in variation of livestock numbers between a range county and an irrigated county in Arizona.

total of about 110,000 animal units. These old-timers believe that at most times the range was overgrazed. In 1930, 32,000 cattle and horses were grazing on the range about half of the year, and 178,000 sheep not more than 5 months of the year. If these reduced seasons of use are taken into account, there has been a decrease of over 70 percent in the grazing on range lands since 1888. This is an indication of serious reduction in grazing capacity, which must in turn be due to depletion of forage on the ranges. In this case, the depletion amounts to approximately 70 percent of virgin conditions, as shown by an intensive plot survey of the county by the Forest Service in 1932.

Many other range counties throughout the West show materially lower numbers of livestock because of overstocking, although supplemental feed has, in part, offset the decline in range feed. For example, numbers of livestock expressed in animal units in Malheur County, just across the Oregon line from Owyhee County, Idaho,



have declined, according to the census, about 30 percent between 1900 and 1930; and in Rio Arriba, Socorro, and Sierra Counties, N. Mex., 60, 68, and 52 percent, respectively.

While numbers of livestock in most range counties have been declining, other counties in which considerable irrigation has developed have shown marked increases and thus have offset the range counties in the figures for the State as a whole. Maricopa County, Ariz., for example, had only 8,000 animal units according to the census of 1890; but by 1900 it had 89,000 animal units; and 151,000 by 1935—an increase of 70 percent since 1900. Figure 57 illustrates this trend in contrast to the 39 percent decline in Cochise County, a range county in the same State. Yakima County, Wash., had 46,000 animal units in 1910 and 114,000 in 1930. Although the actual increase in animal units has not generally been so great, many other counties in which irrigation has been developed have shown increases up to 50 percent.

All in all, the evidences of excessive stocking shown by livestock numbers are marked. Declines of 24 percent in animal units grazing on ranges in the range portion of the Plains States since 1920, and of 20 percent in the 11 far-western States since 1890, have added importance when it is considered that many areas of poor accessibility have been opened up since 1890 and most range livestock are now being carried on a subsistence basis. Similar declines are evident in important range States, and even greater reductions in many range counties. The greatly increased feeding of supplements more costly than range forage is still another striking evidence that present numbers carried on the range represents in most cases excessive stocking.

#### EVIDENCE AFFORDED BY RANGE DETERIORATION ITSELF

Severe depletion, as brought out in the preceding chapter, has occurred generally on western ranges. All types and all parts of the West have suffered. In the aggregate, range lands show a deterioration of 52 percent. No other explanation for this depletion than excessive stocking and overgrazing in their various forms can be deduced from the evidence at hand.

#### DEPLETION NOT DUE TO CLIMATE ALONE

Stockmen generally point to drought as the primary cause of depletion of their ranges. The importance of this factor has already been made clear, but there is no substantial evidence that it is the decisive factor in any but exceptional cases. There has been no general recent change in climate despite the recent dry cycle of 5 to nearly 20 years in different parts of the West. In the northern plains, according to the climatic records at Miles City, one of the oldest stations, the recent dry cycle is no worse than the dry period of the eighties nor as long.

Specific evidence that climate alone is not responsible for depletion appears in the comparable quadrat records of conservatively grazed and ungrazed plots on semidesert ranges of southern New Mexico (93). Conservatively grazed areas varied with rainfall almost di-



rectly, as did ungrazed comparable plots. On the other hand, range areas excessively stocked deteriorated more rapidly, recovered more slowly, and consistently supported a poorer stand of forage.

Fenced and conservatively used areas throughout the West are invariably better than excessively stocked and therefore heavily grazed ranges. But drought does not stop at fence lines.

#### REASONABLE GRAZING NOT DETRIMENTAL

Investigations have shown that a reasonable degree of cropping is not detrimental to plant growth. Studies (116) in the mountains of central Utah indicate that "grazing closely twice or even three times in a (summer) season, provided the first grazing is late enough and the intervals are sufficient for the vegetation quite to recover from each cropping, ordinarily does not seriously affect the yield and vigor of the plant cover."

The sand hills of Nebraska already cited are an example of a large area under private ownership, about 12 million acres, where the vegetation has been maintained or improved in recent years under grazing. There, slight deterioration of the vegetative cover is so apt to start blowing of sand that damage can be readily recognized. Rainfall is sufficient, and the character of the vegetation is such that when the cause of damage is overcome a rather rapid recovery is made.

Under regulation of grazing on the national forests an effort has been made to adjust numbers of livestock to the sustained grazing capacity of the range forage. While there is still more or less depletion of ranges from their virgin conditions prevailing within national forests, and while adjustments in recent dry years have not entirely kept pace with depletion, most of the national forest ranges under grazing use have shown improvement in forage conditions since they were placed under administration by the Department of Agriculture.

Even on semidesert grass and shrub ranges of the Jornada Experimental Range in southern New Mexico, where vegetative conditions vary widely from year to year, studies (93) show that, on sandy soils—

\* \* \* the average density of black grama over the 13-year period (1915 to 1927) was practically the same under conservative grazing as under no grazing. The decline during drought was rather similar under both conditions, but the return of favorable rainfall brought more rapid recovery under conservative grazing. Conservative grazing appears to break up the large, separated tufts formed under freedom from use into smaller tufts better adapted to make efficient use of the available soil moisture, \* \* \* black grama remains dominant after drought in spite of the rapid inroads of associated grass and weed species.

A somewhat similar improvement and maintenance of tobosa grass areas on clay soils was noted within the Southern desert shrub type (30).

#### PLANT INDICATORS OF OVERGRAZING

A plant is, in effect, a plant-food factory. It does not draw its food already manufactured from the soil. It must take up water and essential plant-food elements from the soil via the root system and transport them to the leaves where, together with carbon dioxide taken in through the leaves from the air, it manufactures the ma-



terials which make possible its further growth, the development of seeds, and—of particular importance in range management—the storage of food for winter maintenance and the beginning of herbage growth the following spring. If the leaves which form this manufacturing plant are consumed before sufficient foods have been formed to take care of the essential growth functions, the plant's vigor will be sapped. If the food supply is inadequate, the plant may succumb. It is of vital importance, therefore, to have a substantial leafage available on plants during the growing season.

In the semiarid range country of the West there is naturally a critical balance between the moisture available for growth and the needs of the plant cover, with a resulting competition for moisture. Where grazing is introduced and the range is overstocked, the palatable plants are grazed first and most heavily and are naturally the ones to suffer most in this intense competition. The inevitable thinning of the palatable plants releases the secondary species and gives them the opportunity to increase in density. Where they in turn are heavily grazed, in the absence of the more palatable plants, opportunity is given for still less palatable species to gain dominance.

Overgrazing for an extended period will thus leave "earmarks" which can usually be recognized (79), especially in the scarcity of the choicest range plants and the predominance of low-value annual weeds and grasses, or other plants which have little or no value for grazing. Along with these signs will be others equally obvious, the presence of dead and partly dead stumps or stubby branches of shrubs, noticeable damage to tree reproduction, and erosion and barrenness of the soil, usually accompanied by a series of stock trails terracing the slopes.

To recognize current overgrazing is more difficult, yet it is important in order to make timely adjustment. It is seldom that all species are of equal palatability on a range. Since it is the important palatable plants which furnish the bulk of the feed, it is essential to use them as helpful criteria, to observe closely the degree to which they are grazed, and to stock on a basis that will not injure them. Many palatable grasses on western ranges can only sustain their vigor and density under a degree of grazing which will utilize by the end of the season no more than 70 to 80 percent of their herbage production. Of sod-forming grasses, such as most gramas, and on soils that are moderately compact, a slightly higher percentage of herbage may be taken in years of favorable rainfall. With some bunchgrasses, however, and on sandy soils, it may not be wise to utilize even 70 percent of the palatable herbage. Palatable shrubs can seldom maintain their vigor when more than 75 to 80 percent of the tender twigs and leafage is grazed. Still, on most ranges, and especially on those inadequately regulated, palatable plants are being grazed more closely than these percentages even in favorable years when maximum herbage is produced on each plant.

On nearly all ranges many plants of moderate and low palatability are present, which give the appearance of considerable "feed" when those that are more palatable have been utilized as fully as they can withstand. Dominance of secondary species prevails on millions of acres of ranges depleted in excess of 50 percent, and even on some



showing a 25- to 50-percent depletion. On some of the more seriously deteriorated ranges these secondary species have been replaced and only low-value or worthless plants remain. Such is the condition of many of the ranges depleted in excess of 75 percent. In the light of such evidence, can there be doubt that excessive stocking with its inevitable overgrazing has been an important factor in range depletion?

EVIDENCE AFFORDED BY PRESENT STOCKING AND ESTIMATED GRAZING CAPACITY

Table 28 shows the approximate present stocking and estimated grazing capacity of range lands by ownership jurisdictions. The figures on present stocking on the national forests and Indian lands are from actual records. Those for other jurisdictions have been approximated from the best available information. The estimates of grazing capacity are based upon field surveys of recent years and careful examination of some 20,000 vegetation plots representative of all range types and ownerships.

These data show that, even after the removal of large numbers of livestock in 1934, there were still on January 1, 1935, approximately 17.3 million animal units on ranges within the range territory, of which approximately 10 million were on ranges in the 11 far-western States. In every ownership class more livestock are now grazing range lands than the estimated grazing capacity would indicate could be supported on a sustained basis year after year. They also indicate, considering the quality of the range, a much heavier stocking on public domain (including grazing districts) and on State ranges than on national forests.

TABLE 28.—*Present stocking (Jan. 1, 1935), estimated grazing capacity, and degree of excess stocking on usable western range*

| Region and ownership jurisdiction | Present<br>stocking                    | Present<br>estimated<br>grazing<br>capacity | Degree of<br>overstock-<br>ing <sup>1</sup> |
|-----------------------------------|--|---|---|
|                                   | <i>1,000<br/>animal-unit<br/>years</i> | <i>1,000<br/>animal-unit<br/>years</i>      | <i>Percent</i>                              |
| 11 far-western States:            |  |   |   |
| National forests.....             | 996                                    | 930   | 7.1   |
| Other Federal.....                | 1,804                                  | 1,018                                       | 77.1  |
| Indian lands.....                 | 585                                    | 435   | 34.5  |
| State, county, municipal.....     | 834                                    | 481   | 73.4  |
| Private.....                      | 5,813                                  | 4,270                                       | 36.1  |
| Total.....                        | 10,032                                 | 7,134                                       | 40.6  |
| Range portion (6 Plains States):  |  |   |   |
| National forests.....             | 22                                     | 22  | —   |
| Other Federal.....                | 20                                     | 15  | 35.6  |
| Indian lands.....                 | 86                                     | 59  | 46.1  |
| State, county, municipal.....     | 1,079                                  | 476   | 126.5                                       |
| Private.....                      | 6,053                                  | 3,126                                       | 93.6  |
| Total.....                        | 7,260                                  | 3,698                                       | 96.3  |
| Total range area:                 |  |   |   |
| National forests.....             | 1,018                                  | 952   | 7.0   |
| Other Federal.....                | 1,824                                  | 1,033                                       | 76.5  |
| Indian lands.....                 | 671                                    | 494   | 35.9  |
| State, county, municipal.....     | 1,913                                  | 957   | 99.8  |
| Private.....                      | 11,866                                 | 7,396                                       | 60.4  |
| Total.....                        | 17,292                                 | 10,832                                      | 59.6  |

<sup>1</sup> Excess over present estimated grazing capacity.



As previously indicated, the present stocking of ranges in the Plains States may indicate heavier overstocking than actually prevails because of the unknown quantity of concentrates shipped into the area, the grain fields which are grazed in winter or as stubble, and the heavy movements of cattle out of the area in the spring—this last factor affecting especially State and private lands in Texas.

It will be noted that the degree of excess stocking amounts to about 7 percent on national forests. This is the lowest of all and reflects the efforts of the Forest Service to keep grazing within proper limits. The greater part of this overstocking on national forests is the result of deterioration from drought and the heavy demand from permittees to maintain their herds during that period when their own ranges were extremely short of feed. During the drought of 1934, for example, larger numbers of livestock were carried on national forests than normally and for a longer season.

Although overstocking shows up more seriously because of the combined deterioration from drought and overgrazing, especially in the Plains States, it indicates a very serious situation in all parts of the West. This is especially true of the public domain, part of which is being placed under administration in grazing districts, where it will require a 43-percent reduction in number of livestock now grazed to overcome the 77 percent overstocking which prevails. Average excess stocking of about 60 and 100 percent on private and State lands, respectively, indicates the serious situation prevailing on these ownerships and helps to explain the severe deterioration in grazing capacity already discussed in an earlier chapter.

#### EVIDENCE AFFORDED BY SERIOUS LOSSES AND UNSATISFACTORY PRODUCTION

When more livestock are on a range than the available forage crop will support, it is obvious that a shortage of palatable range feed—at least toward the end of the grazing season—with consequent starvation will result.

On ranges on which the palatable plants, such as perennial grasses, have been replaced largely by such low-value plants as common sagebrush, greasewood, and rabbitbrush, grazing of approximately the numbers formerly placed on the range now results in the livestock subsisting almost entirely on low-value plants. Stockmen and representatives of the Bureau of Animal Industry report increasing losses among sheep on the winter, or so-called "desert" ranges of western Utah, primarily from malnutrition. This is not surprising in view of the fact that the forage value of these ranges is now only 36 percent of that of comparable areas in good condition, as shown by a survey of the situation made by the Forest Service in 1932.

Poor or emaciated condition of livestock frequently contributed to losses from other causes. Animals in a weakened condition are naturally less resistant to many diseases, there is greater danger of loss from predatory animals, and weak cows are commonly lost in boggy places. The mortality from poisonous plants is also invariably heaviest when livestock are hungry or when the range is closely grazed.

Official estimates of the Department of Agriculture record annual death losses of 9 percent or more among grown sheep as a rather



common occurrence in the principal range States, even in years that were not particularly dry. Since these estimates include losses on farms, where the average loss is lower, there is little doubt but that range losses are even more severe than the State averages. Furthermore, range losses are greatly reduced by supplemental feed. Under conservative grazing and good range conditions, with adequate supplemental feed for emergencies, losses are usually not in excess of 5 percent and sometimes are lower.

Losses among range cattle are also two or three times as high on most unmanaged range areas as they are on conservatively grazed ranges in good condition. With average annual losses of about 7 percent among cattle in the range States in many years, there can be little question that inadequate feed from overstocking is a potent factor.

In drought periods, especially in the Southwest, and during severe winters on northern ranges, losses of livestock in a weakened condition from a range-feed shortage on overstocked ranges often become appalling. From 25 to 35 percent of some herds are lost in such so-called "die-offs." On the other hand, herds on lightly or moderately stocked ranges weather such adverse conditions with losses but little greater than their average, usually not exceeding 3 or 4 percent.

Low calf and lamb crops are but another evidence of excessive stocking. Cows and ewes in a weakened condition from feed shortage or other malnutrition often fail to breed during the year, and calf and lamb crops on western ranges accordingly are lower than is desirable. Official estimates of the Bureau of Agricultural Economics, for example, show that in New Mexico, for the 11-year period from 1925 to 1935, the average lamb crop amounted to only 62 percent, reflecting, at least in part, a scarcity of feed on the ranges in most years. In 1926, following a year of fairly good rainfall and low numbers of sheep in the State, the lamb crop amounted to 78 percent. In 1932 and 1933, with about a third again as many sheep and following average or better years of rainfall, the lamb crops were only 52 and 50 percent, respectively. This would indicate that there is some relationship between low lamb crops, excessive stocking, and poor feed.

In southern Arizona the calf crop of representative cattle outfits using unregulated, heavily grazed ranges averaged only 55 percent<sup>15</sup> for the 8-year period 1916 to 1923, inclusive. Since average annual losses amounted to more than 10 percent, net production was only 45 calves for each 100 breeding cows, inadequate for profit. This is in contrast to an average calf crop of 72.6 percent for the same period, on the comparable but more conservatively grazed range, in good forage condition, within the Santa Rita Experimental Range. Here losses from all causes amounted to 3.2 percent and net production was 69 calves for each 100 breeding cows, or more than half again as many as on the depleted, overstocked range.

On heavily stocked semidesert ranges in the Southwest (50), and on brush ranges of southwestern Utah (53), many cows calve only every other year. Under such conditions calves grow out poorly and require an extra year to attain a weight comparable to calves from better and more conservatively grazed ranges.

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<sup>15</sup> United States Department of Agriculture, Forest Service. Field Day Program. Santa Rita Range Reserve. 20 pp., illus. 1925. [Mimeographed.]



Even on good short-grass plains range of eastern Montana, lower calf crops and poor development of calves are clear indications of overstocking. Sixty young cows have been grazed for over 3 years on experimental range pastures at the United States Range Livestock Experiment Station near Miles City, Mont., under the supervision of the Forest Service in cooperation with the Bureau of Animal Industry. All ranges were in good condition at the start. Twenty of these cows have grazed 23 acres per cow per year, and this is considered to be approximately a 25-percent overstocking. Their average calf crop for the 3-year period 1933 to 1935, inclusive, has been 70.0 percent, in contrast to 81.7 percent from the 40 cows on more conservatively grazed pastures. Net calf production in pounds per cow has been 194.5 pounds for the 23-acre-per-head group and 264.3 for the groups on more conservatively grazed range—a severe penalty for such overstocking, even though range depletion in this instance was very slight until the 1934 drought.

A slight loss in weight of the cows, such as prevailed on the overstocked range pastures, and even the lower calf weights, are often not recognized by stockmen. Furthermore, on some ranges secondary species, while not as palatable, may be almost as nutritious as the more palatable species. Accordingly, slight deterioration of range may not be sufficiently reflected in the condition of the livestock for stockmen to realize the injury that overstocking is doing to the range and through it to their own ultimate well-being.

Such increase, if any, as has occurred in meat and wool production in the Western States has been principally due to changes in class and age of livestock, improved breeding, increased feeding, and other production factors, rather than because of maintenance or improvement of range feed. During the latter part of the nineteenth century, 4- and 5-year-old steers were commonly shipped, grass-fat, from ranges; at present, breeding cows predominate on the range. Calves are often sold in the fall or yearlings are marketed in spring or fall, especially in the Southwest. In other places many steers are held over until they are 2 or 3 years of age. During the early years of the western sheep industry, wethers predominated on the range. Later, as the public taste for lamb increased and as wool prices fell, the wether herds gave way to those made up of breeding ewes from which fat or feeder lambs are marketed. Furthermore, there has been a marked improvement, especially in the last 20 years, in the grade and type of animals grazed. Scrub bulls and rams have practically disappeared from the range country, being supplanted largely by purebreds or very high-grade sires. Herds are culled closely. The net result has been a greater production per animal. Wool production per animal has about doubled in the last 50 years.

On many range areas, however, much of the advantage to be gained from the improved breeding and other livestock management has been lost. To develop well, the better bred animals require adequate feed. In many years calves are stunted, lambs must be sold as low-grade feeders rather than as killers, and wool production is hampered by scant and uncertain range feed supplies. In drought years the situation often becomes acute; heavy starvation losses occur in the breeding herd and well-bred breeding cows are sacrificed at



forced sale. Usually the unfavorable range conditions are not so severe on sheep, although herds have been decimated by feed shortage from drought and severe winters. Thus, years of careful breeding may be lost in a single year because of range feed shortage from excessive stocking and range depletion.

#### CAUSES OF EXCESSIVE STOCKING

The causes of excessive stocking include: Competition for the use of range lands; the stockman's belief that profits result from maximum numbers grazed; permitting ranges to suffer in the attempt to reduce expenses; stocking on the basis of better years; restocking too soon after drought; pressure to graze maximum numbers on public ranges; the failure of certain public agencies to face their conservation responsibility; and finally, a lack of realization of the consequences.

#### COMPETITION FOR RANGE

On unregulated public domain and the intermingled uncontrolled private and State land, the possession of the range has been largely dependent upon such heavy use that even though a stockman might desire to reserve range forage for contingencies, to do so would simply invite others to come in. Accordingly, the resident stockman has stocked his range excessively to keep the forage reasonably well grazed as it grew. Since many small tracts of private- and State-owned land are intermixed with unregulated public domain, the unrestricted use which has prevailed on the 149 million acres of usable range on the public domain has affected probably 150 million acres in addition. Even with the establishing of 80 million acres of grazing districts under the Grazing Act, doubtless more than 100 million acres of intermingled ownerships will still be open to grazing use by all comers and will continue to be excessively stocked until provision is made for its management.

#### STOCKMEN BELIEVE PROFITS DEPEND ON NUMBERS

Stockmen primarily concerned with making ends meet or in making a profit, to which they are justly entitled, generally believe, even in the face of periodic financial difficulties, that the greatest financial return results from grazing the maximum number of livestock on the range. When high prices prevail they sometimes hold surplus breeding stock on already crowded ranges in an effort to increase production. On the other hand, when prices are low they often attempt to carry over salable animals for a higher market, with inevitable overstocking of the range. Loans usually have been negotiated on livestock numbers almost regardless of costs, ability of the range to support the number grazed, or net production. In some instances loaning agencies have unwittingly encouraged overstocking when prices have declined by requesting stockmen to retain young salable breeding stock in order to reduce the per head value of the loan. By so doing they have overstocked and often undermined the range forage resource which, in the last analysis, supports the loan.



## PERMITTING RANGES TO SUFFER TO REDUCE EXPENSES

Ranges are permitted to suffer in the attempt to reduce expenses. The relatively high cost of supplemental feed, especially on areas where it is not abundant, leads to turning livestock on ranges before forage plants have attained sufficient growth to prevent injury. Similarly it leads owners to leave stock on the range so late in the fall and winter that trampling may do severe damage to saturated soil. Such practices are common throughout the West. In Utah and Idaho they have seriously impaired the grazing value of millions of acres of spring-fall range.

## STOCKING ON BASIS OF BETTER YEARS

In years of good rainfall and favorable climate, the forage on the range makes a good growth and livestock do well as long as abundant feed lasts. This naturally encourages users to make the most of the available feed and inevitably leads to excessive stocking when forage production drops in dry years. In view of the deterioration which such heavy stocking in dry years brings about, as has already been discussed in connection with the effects of climatic variations, it would seem that the fallacy of stocking ranges on the basis of feed production in good years would be evident and that definite provision would be made for leaving a substantial margin of range feed in the average or better year. Still, many users stock on the basis of the better years, hope for rain, and, when the range deteriorates from overstocking and average rainfall consequently fails to produce the forage they expect, believe they are in a drought period.

## RESTOCKING TOO SOON AFTER DROUGHT

Climatic changes have a way of playing tricks with the vegetation that are sometimes deceptive. As pointed out in the discussion of climate, the stand of perennial grasses is less dense in the year following a drought than during the drought year itself. When unusually favorable rainfall follows a drought year, as is sometimes the case, the reduced stand of vegetation makes an exceptional height growth and appears to be abundant. This often leads to prompt restocking. Too many livestock at that time may so closely utilize the forage as to seriously affect recovery from the drought.

## PRESSURE ON PUBLIC RANGE OFFICIALS

On publicly regulated range such as on the national forests, many permittees exert constant pressure to be allowed larger numbers than they are now permitted. Some challenge reductions necessary to control overgrazing, even when they realize that the ranges are suffering from overuse. The hope always exists that climatic conditions will bring better feed the following year. This desire to prevent reduction in livestock numbers regardless of overstocking has even crept into the provisions of the Grazing Act.



## SOME AGENCIES HAVE NOT FACED THEIR CONSERVATION RESPONSIBILITY

Grazing leases of State lands and on certain Federal reservations have been made without adequate thought for perpetuation of the resource. Ordinarily, there has been lack of knowledge of actual conditions on the range and either inadequate or complete absence of inspection of actual use and management of the lands administered. The net result has generally been the grazing of more livestock than the range could support on a sustained basis.

Many leases of such lands provide for the continued grazing of the number then grazing on the range or for the average number which have grazed over a period of years. Such stocking is often spoken of as grazing capacity and is sometimes used without field check of range conditions as a basis for proposed adjustments. If range forage has been adequately maintained, average numbers grazed furnish an excellent criterion. If, however, through overstocking, the value of the range has greatly declined, there can be no assurance that the range will continue to carry the number previously grazed. In fact, continued grazing of the same number will simply accentuate the degree of overstocking and intensify range deterioration. Often under such conditions a drastic reduction in livestock of one-fourth, one-half, or even three-fourths may be necessary to check further deterioration and start recovery.

## LACK OF REALIZATION OF CONSEQUENCES

Stockmen are apt to overestimate the grazing capacity of their owned, leased, or publicly controlled land because of lack of knowledge of what the range will support on a sustained basis or because of a failure to take into consideration all of the factors involved. There is a lack of adequate knowledge of just what grazing capacity is and of simple measures to determine it. This is a fertile field for research.

The public also fails, generally, to recognize the serious consequences of overstocking to the livestock industry and to community welfare, or to take prompt action after recognition. Here in the United States the whole social system has been built upon individual initiative and action, a vital factor in development but an encouragement to destructive exploitation. For years the unreserved public domain has been a grazing common. Now and then the injured public, on their own volition, took action to correct some particularly bad situation, such as the closing of the Manti Canyon watershed to sheep grazing about 1900 after disastrous floods had caused great damage in the town of Manti (108). The establishment of the national forests came in an effort to protect forests and mountain watersheds in the public interest. Many additions of range lands have also been made to national forests at the request of users or the interested public to protect more adequately the resource values for community benefit. However, even though conditions on the majority of range lands have continued to affect community welfare seriously, the interested public has hesitated to take action.



## OVERCOMING EXCESSIVE STOCKING NOT INSURMOUNTABLE

With several hundred million acres excessively stocked and seriously depleted, the stemming of potential range destruction may seem like a hopeless task. Although the situation was rather critical in 1934, during that year the drought, depressed prices, and purchases by the Federal Government of drought-stricken livestock greatly reduced livestock population. However, numbers of livestock increased during 1935 on many ranges. True, shipments from ranges and starvation losses have been so large that conservative increases can be made in limited localities within the next few years after the ranges recover from their present impaired productivity. In most cases, however, the break-down of ranges from past overstocking and the recent drought is so great that livestock on range lands still exceed the grazing capacity by approximately 62 percent and will have to be reduced by 38 percent in order to overcome the overstocking. Ways and means of developing an understanding of the proper basis for stocking to sustain production of forage and livestock, a willingness on the part of users to adjust stocking to safeguard against impairing production, and regulation of public ranges which will protect them against abuse are features which will need consideration in order to overcome excessive stocking now prevailing.





## RULE-OF-THUMB MANAGEMENT

By M. W. TALBOT, Senior Forest Ecologist, California Forest and Range Experiment Station

As the frontier retreated westward into a land of no fences and few familiar kinds of forage, the wide expanses of inviting range brought both rich opportunities and a host of knotty problems. As great numbers of cows and sheep pressed upon the heels of the vanishing buffalo and swarmed over the free-grass country, a unique brand of thought and attitude evolved. This western range philosophy was quite logically the outcome of the challenge of a strange environment to the sturdy pioneer stockman and of his attempts to adapt his growing needs to the strange conditions.

The early stockman had to develop a whole new system of range husbandry. In the absence of adequate experience or research facts, management of the grazing resource developed largely—and quite naturally—from a basis of rule-of-thumb. Thus the term implies all the sundry kinds of range practices that had their beginning in the stern necessities of pioneer times and that, in varying degree, still persist. Many of these practices, backed by excellent judgment, have stood the test of years. Noteworthy are riding, roping, branding, etc.—the whole technique of handling livestock, in which high proficiency has been attained.

Many other practices, however, have led to range depletion and consequently have proved to be unsound from the standpoint of perpetuation of the range resource and its other public values. For these practices the stockman must share the blame. Still, in examining them for clues to their correction, one must recognize that the stockman has been in the grip of powerful economic forces to a varying but considerable degree. It was inevitable that many individuals confronted with the problem of making a living would be led into range practices that are, in the end, damaging to the land. Just how, then, have these defective practices operated?

### HARMFUL PRACTICES EVOLVED BY RULE-OF-THUMB

#### TOO MANY ANIMALS ON THE RANGE

Most range deterioration can be traced back to the attempt to graze more animals than the land can safely support from year to year. Drought, lack of knowledge of what the range will stand, the urge for greatest immediate profit, economic pressures, and other contributing factors have all played a part. But most of these have been expressed in terms of overstocking, which still looms as the most spectacularly destructive of rule-of-thumb practices. Because of its high importance as a major factor in depletion, the preceding section of this report has been devoted to a detailed discussion of its widespread occurrence, its various causes, and its destructive effects.

## FAULTY DISTRIBUTION OF LIVESTOCK

Uniform grazing over all parts of the average western range unit is rarely obtainable because of variations in topography, timber or brush cover, kind of forage, location of watering places, and similar differences. Certain parts of a range are thus grazed more heavily than others; these are the critical spots or tension zones in which range damage has been most pronounced.

## CONGESTION OF LIVESTOCK IN VALLEYS

Crowding of choice range is partially explained by the fact that most western ranges produce "pie" or "ice cream" forage, as well as "hardtack." Livestock prefer the lush forage of mountain meadows, for example, to the drier bunchgrass on surrounding timbered or brushy slopes. Moreover, cattle tend to drift to the more accessible, comparatively open, and usually better watered meadows, neglecting the outlying feed; and sheep are more easily herded in the open areas. Allotting livestock to ranges on the basis of the forage crop on their total acreage has thus quite obviously meant excessive numbers of animals on the comparatively small meadows, canyon bottoms, and other areas of choice feed. The inevitable results, overgrazing, reduced forage crop, increased erosion, and impaired watershed value, can be illustrated by two examples.

A spectacular illustration is the Canada de los Alamos, a privately owned meadow in the Santa Barbara National Forest, Calif. In 1880 a horse could step across the tiny creek meandering through this valley. Depletion of the vegetation carpet through continual overgrazing, combined with occasional rainstorms of great intensity, have brought about a striking change of scene—a great "barranca" (gully) 100 feet deep, 200 feet wide, and several miles long; an abandoned ranch house menaced by the encroaching arroyo; and permanent depletion of range values through lessened valley-floor water and volume of forage.

An historic stage-stop on one of the early emigrant routes furnishes an even more convincing example of range destruction. Mountain Meadows, Utah, at the time of first settlement in 1862 was a fertile sod-bound valley of several thousand acres. A recent survey by the Intermountain Forest and Range Experiment Station reveals a striking contrast—as a result of man's occupancy, with his roads, ditches, and hungry herds, practically all of the deep-soil portion of the meadow has been worn and washed away, along with most of its original grazing capacity.

As the originally intact plant cover gave way on these and many other overgrazed areas, the most palatable forage plants disappeared and in their place inferior or worthless plants came in and grazing and watershed values dropped (fig. 58).

Equally serious is the "cracking under the strain" of small and inconspicuous mountain meadows ranging upward in size from 5 acres or less. Many of these in their primeval state were characterized by rivulets bordered by willows and grassy glades. Here, as in the big valleys, overgrazing was followed by thinning of sod, killing out of the willows, cutting of gullies, lowering of the water table, and drying of soil.



In appraising the significance of similar examples, which abound throughout the West, one who has reviewed the imposing array of evidence, locality by locality, states the conviction that serious range erosion in the Southwest followed close on the heels of excessive grazing by big herds on key areas (22). "The coincidence between the introduction of large numbers of stock and the cutting of arroyos indicates that overgrazing precipitated this form of destructive erosion" (23). And, in both the intermountain and southwestern regions, depletion and modification of plant cover incident to and following settlement and livestock ranching may be regarded as a probable cause of much subsequent erosion of valleys and mountain meadows, according to various geologists as well as foresters and



FIGURE 58.—GOOD RANGE PLANTS GO OUT WITH OVERGRAZING

Long-continued overstocking of the valley range on the right has resulted in the disappearance of the valuable saltbrush still abundant on the protected range across the fence, a thinning of sod, and an increase in small worthless shrubs. The net result is greatly reduced grazing capacity.

range technicians (10, 51, 62). The net result of overgrazing caused by poor distribution of stock has been the same, in varying degree, on thousands of valleys and mountain meadows throughout the West.

#### EXCESSIVE USE OF SHEEP BED GROUNDS AND CLOSE HERDING

Prohibited on the national-forest grazing grounds and the more closely supervised privately owned ranges, excessive use of sheep bed grounds and camps is still prevalent on unregulated portions of the public domain and on many private ranges, more particularly those of absentee owners, in spite of the fact that its evils have been quite apparent for over a third of a century (38, 48). The usual explanation is that the herding of sheep is somewhat easier from semipermanent camps, the use of which reduces the inconvenience of moving camp every 3 days, or oftener. Too frequently, therefore, the tendency has been to use the same camp for many nights



in succession, trailing the bands of sheep back and forth between the overused bed ground (adjacent to camp) and the outlying feed. In consequence, before the camp is finally moved, the bed ground and a needlessly large surrounding area has been severely trampled and grazed—in extreme cases even partially denuded, with the resultant loss not only of grazing capacity but also of much valuable topsoil from areas “grazed into the ground” year after year.

Much range damage also has been caused by closely massed herds of hurried jostling animals forced to graze in crowded compact bunches. With close herding feed is wasted through unavoidable trampling, and strain is increased on key portions of the range which usually are most in need of protection. To this extent close herding leads to the same evils as prolonged use of bed grounds.

Furthermore, unnecessary trailing by either sheep or cattle has caused great wear and tear on the soil-binding plant cover of swales and valleys. In little paths or trails the grass wears through to the soil. Down the deepening trails the water “first crept, then ran, and finally tore \* \* \*” until great washes were formed—the gullies and arroyos which have seamed and scarred the western ranges in every direction.

#### INADEQUATE OR POORLY LOCATED WATERING PLACES

An insufficiency of stock waters, a condition found on much of the semiarid western grazing grounds (13), leads to excessive trampling about the water and increased trailing between water and feed (139). The destructive effect on the range is illustrated by conditions around a well in Millard County, Utah, on winter range where watering places were too far apart. Excessive numbers of sheep had been watered here for 8 years. Within a radius of 1,000 feet only 4.3 percent as much grass remains as on similar range 15,000 feet distant. Even within a 2,000-foot radius the forage has been reduced to about one-sixth of that on the more distant range, and the highly palatable plants have been obliterated.

As a result of depletion in its various aspects not only has the plant cover around this watering place been made much thinner and the soil exposed to wind and water erosion, but the vigorous invasion of low-quality forage plants on the desert subjects the valuable plants to such severe competition for moisture as to render the establishment of young plants difficult in the last extreme. Without reasonable reproduction it is only a matter of a few years until the best forage in this type becomes practically extinct (136).

#### POOR SALTING PRACTICES

The pounding of overgrazed spots is aggravated by obsolete salting practices, because salting only at the watering places, or in other places where stock are likely to “bunch up”, nullifies any possibility of attracting cattle into areas of unused or lightly used forage. Experimental work, careful observations, and studies of existing practices of progressive stockmen on national forests and many private ranges have pointed out that salt is a “cheap cowboy.” Systematic salting can be used to lessen undue bunching and overgrazing on areas where the animals tend to congregate (32, 39, 79).



To the degree to which no advantage has been taken of this progressive handling measure for effecting proper distribution of stock inadequate salting practices have contributed their share to range depletion.

#### IMPROPER SEASON OF USE INJURES THE RANGE

Too early spring grazing on mountain ranges, another cause of local range depreciation, is an outgrowth of the insufficiency of spring range adjoining mountain communities, such as the Spanish-American settlements clustered around the base of the Sangre de Cristo Mountains of northern New Mexico, and many others. In the early spring the stockmen, confronted with exhaustion of winter forage, with a limited ability to obtain more supplemental feed, and often the necessity to move stock off the home ranch stubble-fields and meadows in time for plowing and irrigating, have been insistent on turning stock into the high mountain areas as soon as the first green grass appeared in the wake of the receding snow banks. How to bridge this gap in the feed supply still remains an exceedingly difficult problem shared by national-forest administrators and by hundreds of stockmen throughout the West. Illustrative of this difficulty is the fact that proper seasonal use still needs to be brought about on approximately 12 percent of the 9,000 grazing units on national-forest ranges.

To the individual operator, the risk of range injury, if considered at all, usually has been regarded as outweighed by the economic necessity. That early spring injury has been occurring for years on years, however, is shown among others by results of studies in Utah (116), in Colorado (65), and in North Dakota (119), as well as by much general observation elsewhere through the West. When cattle are allowed to "follow the snow" and forage is cropped "as soon as it pokes its nose out of the ground" no plant factory is left to manufacture food to replace that gradually sapped from the scant supplies still stored in the roots in spring. Further injury to both plants and range results from trampling of saturated soils.

It is of especial interest to note that the detrimental effects of summer invasions of Montana winter range by herds and flocks—another example of improper season of use—was referred to, as early as 1900, as "the denuding summer pasturing" (49).

Risk of damage to range and loss of condition of animals also is usually incurred in any attempt to graze short-season ranges for a longer period. For example, on certain California foothills, chiefly valuable for fall, winter, and spring grazing, the short-lived annual forage dries to a crisp in May, and during the long practically rainless summer provides an unsatisfactory ration deficient in vitamin A (68), and certain minerals, particularly calcium and phosphorous—a deficiency usually associated also with low protein (67). If such ranges are grazed yearlong not only is it usually necessary to supplement them to prevent serious loss in animal condition; but, in addition, little or no old grass remains on the "slicked-off slopes" at the beginning of the fall rains, to retard erosion.

Full-season use of the browse ranges of southwestern Utah—areas better adapted to late spring and fall grazing—is followed by a



gradually diminishing stand of the most palatable bushes (53)—another illustration of grazing at the wrong time of year.

The time of grazing has much to do with livestock damage to timber on the Coconino Plateau of Northern Arizona, according to studies of the Southwestern Forest and Range Experiment Station. Most of the grazing injury from browsing of terminal shoots of ponderosa pine "reproduction"<sup>16</sup> occurs when the proportion of succulent forage is smallest. This condition exists each year during two dry seasons, the first from the opening of the grazing period about June 1 to the beginning of the summer rains in early July, and the second and shorter period extending from about the first of October to the end of the grazing season. Lack of proper consideration of the amount of succulent forage available during these critical dry periods has been the principal cause of damage to the regenerating forest. This appears to be even a more important cause than shortage or poor distribution of water.

#### POOR BALANCE BETWEEN CLASSES OF ANIMALS AND TYPE OF RANGE

Local failure to allocate ranges to the class of stock to which they are best suited reacts unfavorably on both stock and range. Illustrations of such maladjustments, as they affect ranges, include (1) placing cattle on ranges so rocky and rugged that animals become footsore, calf crops are reduced, and the most accessible areas are overgrazed (79); and (2) vainly attempting to get full utilization with cattle of ranges supplied with sufficient water for sheep but not enough for cattle.

Sheep, for example, require water less frequently than cattle<sup>17</sup> (78), and consequently can travel farther between feed and water. From the standpoint of forage alone, full stocking of such areas with cattle is inevitably reflected in enlargement of the trampled-out areas around water, increased soil washing, and reduced grazing capacity—the same chain of destructive results discussed in detail in foregoing paragraphs.

Placing both cattle and sheep on the same range usually is equivalent to double use, with its attendant evils. The principle of this so-called "common use" originated from the belief that full utilization of all the forage (maximum grazing capacity) could best be attained by grazing on the same range two or more classes of livestock in numbers corresponding to the quantity of forage that could be used by each class. On numerous ranges where all conditions have been favorable, common use has worked (79). In too many instances in actual practice the attempt at common use has culminated in double use and in overgrazing in varying degree. To just that degree the practice, as it concerns domestic livestock, has proved injurious.

Dual use by domestic livestock and game likewise requires planned regulation to avoid detrimental overuse. In general, there is ample summer range on western forests for present numbers of game animals, and in most cases for increases, without conflict with domestic livestock (154, pp. 527–554). A general deficiency exists, however,

<sup>16</sup> Small trees between the seedling and sapling stages.

<sup>17</sup> United States Department of Agriculture, Forest Service. Report of the District Investigate Committee, District 3. 134 pp. 1930. [Mimeographed.]



in winter range, which includes several million acres of public domain, a large but unknown acreage of privately owned wild land, and the lower fringes of national forests, national parks, and State parks. Much of this winter range for deer, elk, and antelope is badly overgrazed (149), the results being similar to those caused by livestock alone. The spectacular examples that have aroused national interest and concern, illustrate the problems.

The deer herd on the Kaibab National Forest in Arizona increased so rapidly with complete protection that within 5 years after the peak had been reached about 1924<sup>18</sup>, and despite a heavy reduction in livestock, the productive capacity of much of the winter range had dwindled to 5 or 10 percent of the normal forage supply (154, pp. 489-525).

The second example concerns the Sun River elk herd on the Lewis and Clark National Forest in Montana, which reached an estimated total of 4,600 in 1930, with available winter range badly overgrazed. Severe winters, hunting, and other causes have reduced the total to about 3,000 head; but, in spite of a reduction of 78 percent of the domestic livestock on the area, further adjustments must still be made to halt the damage.

#### THE EFFECT OF BURNING ON FORAGE PRODUCTION

Any painstaking analysis of the vexing problem of burning and forage production on the so-called "brush ranges" of the West reveals two major causes: (1) Local confusion and even misunderstanding because of lack of accepted facts on critical phases of the problem; and (2) the occasional inevitable clash of two schools of thought. One group includes some stockmen and others who are faced with the problems of making a living off the range land and have only a mild or secondary interest and concern in its public values. Perpetuation of the basic resources, however, is the obligation of other groups. Quite sincere differences of individual and group opinion are thus involved.

Whether to burn chamise and chaparral lands in California, for example, is a question that has received much general empirical study and observation, supplemented on certain points by detailed studies, chiefly by A. W. Sampson, of the University of California. As temporary advantages of burning "brush" lands, the findings of these studies include, among others, a usual increase in volume of forage and a longer period of succulence for the first year and to a lesser extent during the second year after the fire. Proponents of burning consequently minimize the disadvantages, taking the position that the increase in forage more than compensates for any injury to the range resource.

As an offsetting detrimental finding, however, the increased amount of forage on "burns" is not only very temporary but it is usually obtained through the barter of fertile soil; for soil erosion is increased by burning on the steeper, rougher areas. For these reasons, conservation groups and administrators charged with maintaining productivity of these lands, most of which are included in

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<sup>18</sup> Mann, W. G., and Locke, S. B. The Kaibab Deer, a Brief History and Recent Developments. U. S. Dept. Agr. 67 pp., illus. 1931. [Mimeographed.]



important watersheds, hold the view that on most areas serious injury to the range soil, to the watersheds, and to other public and long-time values outweighs the temporary value of the increased forage.

With reference to sagebrush ranges, observations by Pickford (104) in the Intermountain Region, indicated that promiscuous burning followed by unregulated grazing tends to deplete the stand of perennial grasses and to allow inferior annual grasses to increase in abundance.

The further point should be made clear that many stockmen apply the term "brush range" not only to the chaparral-covered foothills or to sagebrush plains, but also to ranges in the ponderosa pine type in which young timber has crowded out livestock forage in varying degree. In order to hold and increase the area available for grazing, stockmen occasionally have favored burning of such commercial timberlands. The damage resulting from such a practice is great.

In mature timber not only is there a large direct loss in volume but subsequent loss results from decreased growth and from fungous and insect damage (129). A more serious result from the burning of cut-over lands is the progressive destruction of both small and established tree seedlings and the "taking over" of large areas by dense stands of worthless brush. For example, of 13.6 million acres comprising the largest part of the California pine region, 1.9 million acres of potential timber land are now brush fields resulting from fires (128).

And of even more far-reaching importance is the fact that repeated burning of mountain timberlands enormously increases erosion of the fertile topsoil, a fact demonstrated by the California Forest and Range Experiment Station and other agencies. As an illustration, based on actual measurements from experimental plots in one locality, run-off from bare burned soil was shown to be 3 to 30 times greater than that from adjacent forest-covered soil; and the erosion 100 to 1,000 times greater, the higher rates coinciding with higher intensities of rainfall.

#### COMBINED EFFECTS OF UNSOUND RULE-OF-THUMB PRACTICES

The foregoing factors in depletion resulting from rule-of-thumb management have brought about sadly reduced forage values in all parts of the West. Fully half of the western range area, according to recent estimates, is now characterized by severe or extreme depletion as given in detail on page 114 and summarized in figure 59. For example, on open desert ranges in Nevada forage attains only 49 percent of its former value; in Utah, 36 percent; and in the Red Desert of Wyoming, 43 percent of that in the remnants of protected range that are still left, as shown by surveys made by the Intermountain Forest and Range Experiment Station. Moreover, even the protected fragments are thought to be less productive than was the virgin range. This depletion is recognized by resident stockmen who have operated 20 to 50 years on one or the other of these three range units. The older range users have estimated reductions of 20 to 80 percent from the original condition, the amount of their estimated reductions corresponding in general to the time they have



used the range. The story is similar in various other types of western range.

Such heavy reductions in forage values constitute a heavy blow to the grazing industry, because the salt-desert-shrub type is the principal winter range over extensive areas in the intermountain region. Even in their depleted condition, these desert ranges support nearly 2 million sheep from 4 to 6 winter months in Utah; more than a million use them for 3 to 5 months in central Nevada; and probably 2 million use them for 3 to 5 months in Wyoming and Colorado.

How much of the present alarming condition may fairly be charged to the rule-of-thumb basis of attempted management, and how much to drought and other causes? Adverse climate has peri-

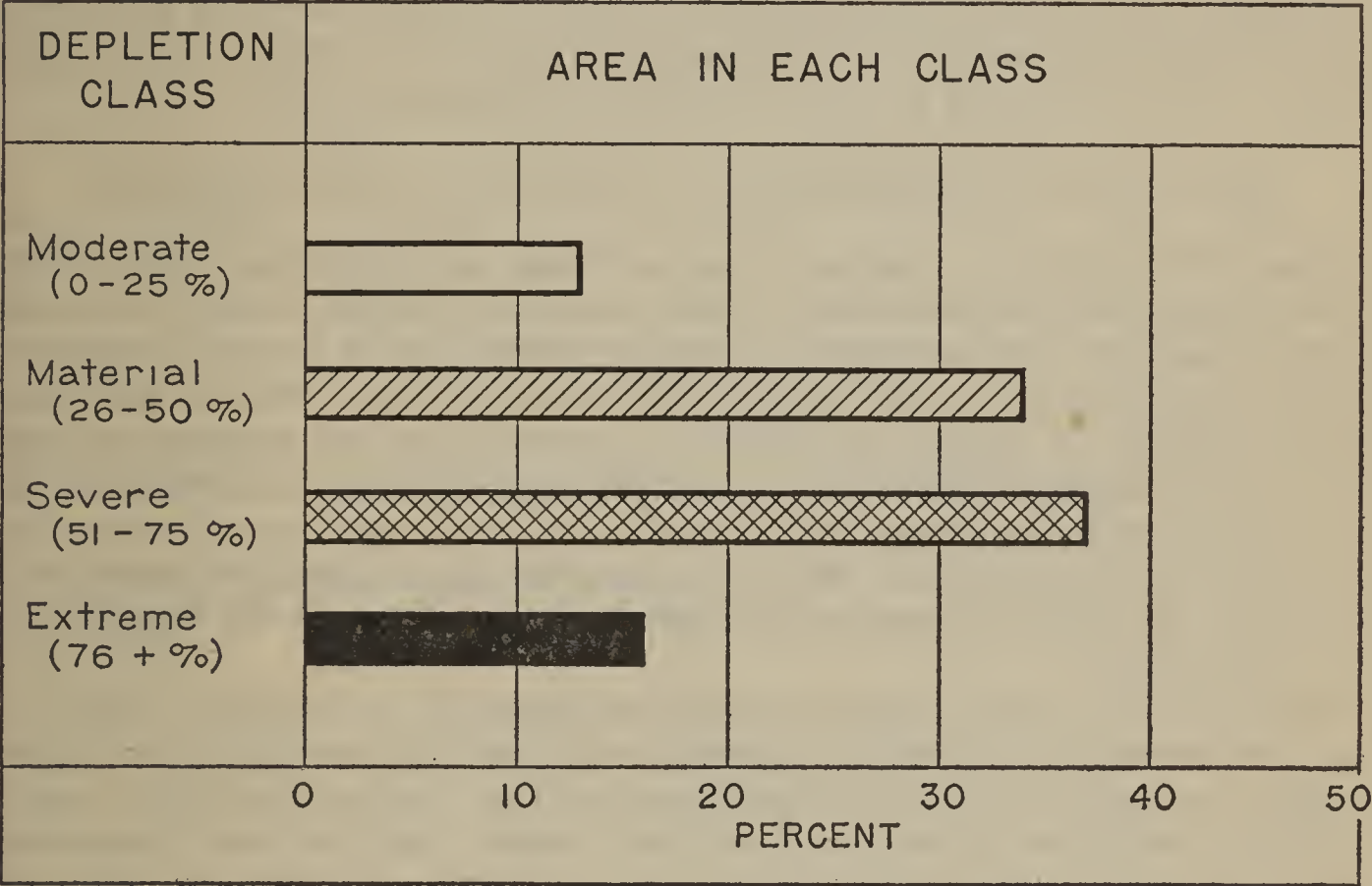


FIGURE 59.—REDUCED GRAZING CAPACITY OF WESTERN RANGE

Less than one-seventh is still in comparatively satisfactory condition, and this portion is more than outweighed by the area on which most of the values have been lost.

odically been a potent contributing factor in the temporary depreciation of many range areas; for, as earlier explained, climatic fluctuations affect in pronounced degree both range forage and productivity. Drought reflected in a reduced forage crop quickly converts what is normally a proper stocking into excessive stocking, and intensifies the damage to ranges already too heavily stocked. But this depletion due to drought alone is only temporary, as explained in a foregoing section; for drought-stricken ranges recover following the return of favorable growing conditions—unless the drought is accompanied (as in recent years it almost invariably has been) by excessive stocking or other bad practices. So, in the long run, it is these rule-of-thumb practices—not climate—which cause ranges to break down.

This conclusion is further strengthened by the especially significant fact that range depletion is rather closely tied in with the class

of land ownership, range deterioration being generally greatest on unregulated, publicly owned lands as well as on the majority of those privately owned; and least on publicly owned areas under regulation and on the notable exceptions of well-managed private holdings. This is not surprising for, as explained later on in this chapter, financial difficulties brought about by overcapitalization, onerous credit facilities, and unstable and fluctuating markets have contributed in no small way to poor husbandry, range exploitation, and the inevitable consequence—range depletion, on free public range and most privately owned range.

Most depletion, then, results directly from overgrazing, which in turn has its origin in defective range-management practices as just explained. The exact amount of depletion properly attributable to these rule-of-thumb practices cannot of course be accurately weighed, but the contrast between the most depleted classes of land and those least depleted affords a rough approximation of the net contribution of rule-of-thumb practices to range deterioration.

#### REASONS FOR DEVELOPMENT OF RULE-OF-THUMB PRACTICES

The evil effects on western ranges from all injurious forces combined, have just been outlined. In considering even briefly the widespread damage one naturally wonders: "Why did it all come about?" Back of this question lie explanations of peculiar interest in themselves, reflecting as they do certain pioneer pages of western history that have passed. Of more immediate importance, however, is the help that the underlying reasons offer in planning how to recapture the disappearing values. Why, then, have many stockmen continued practices that tend to wreck the basis of the industry on which they are dependent?

During the early pioneer years at least, it is doubtful whether any appreciable concern was felt regarding the possibility of damaging the range. Later, as competition for forage tightened, along with the conflicts between sheep and cattle and between stockmen and "nesters", the dominant effort of most stockmen to gain or retain control of the range overshadowed any thought of resultant damage, and led even at times to the malicious "trampling into dust" of areas of feed, to drive back crowding neighbors, or in retaliation. No responsibility was felt for preserving the ranges for the future. As Barnes (14) points out, it was all free, open grazing; Uncle Sam owned it, and "it was a clear case of first come first served and the devil take the hindmost"—virtually the motto of that period. And, permeating each and every chapter of the story of the range—even to the present—maximum immediate profit rather than maintained range productivity usually has been the accepted individual aim. Proper management may also be hindered by local conditions. For example, stockmen using the unregulated public domain, are still to a considerable degree, forced deliberately to overgraze the range in order to discourage competition.

Moreover, vastness of open range and abundance of forage at time of first settlement discounted any need for concern. Perhaps, however, in the words of Barnes:

The stockmen of those pioneer days should not be held to too strict an accountability for their range practices. It was all a new proposition to them.



Few of them knew the first rudiments of forage growth or plant requirements. They mostly grew up with the pioneer idea that when the feed in a certain region was gone there was more "over the range" to which they could move their herds and flocks.

In a surprisingly large number of instances stockmen did not realize the wide differences in range-plant palatability—a vital foundation stone of safe grazing capacity. When all the choice range had been taken up and overstocking and other rule-of-thumb practices, together with drought, began to take their combined toll, range depletion continued without any general realization on the part of stockmen that the range could not withstand the severe treatment indefinitely. Most of them failed to take into account the penalty of guessing at grazing capacity and the forage-crop ups and downs resulting from climatic fluctuations.

The delicate balance between climate and vegetation was completely unknown to stockmen and the interested public, and both were lulled into a false sense of resource security. Therefore, when unexpected drought set the stage for range break-down, the attendant livestock losses were bemoaned, but complacent faith was, and still is pinned to perhaps the greatest fallacy in range land—the far-too-prevalent belief that "one good rainy year will bring the ranges back." Studies to date indicate precisely the contrary result in many western range types where the important forage plants are dependent upon seed for their perpetuation. A convincing illustration of the slow recovery of bunchgrass types is furnished by Forest Service records from 1912 to 1935 from 50 quadrats on Arizona pine ranges that were overgrazed when established. None of these regained maximum forage density in 12 years under fence and four-fifths of them had not entirely recovered after 21 years of protection.

Then, too, much range damage in its early and often obscure stages occurred undetected, because the average stockman, in most ways a keen observer, was not looking for it. Moreover, in many places the first danger signs, such as incipient erosion and a slight increase in inferior range weeds, were not always reflected immediately in livestock condition. Finally, there was a lack of depletion "yardsticks"—criteria by which the significance of these first changes could be understood.

Locally, observant stockmen, of course, did realize the full import of these changes—and a long time ago. The secretary of the California Wool Growers' Association, for example, in writing in 1863 of conditions in that State (101) alluded to sheep ranges:

Where the lands have been so persistently overstocked [that] the herbage has necessarily become thinner and thinner \* \* \*. This process of depasturage, though not confined to any one species of herbage, is most strikingly exhibited in the great oat ranges. \* \* \* This system of stocking the grazing lands must ultimately result in their entire depasturage. \* \* \*

Thus a note of alarm regarding overstocking and range decline in one region, the Pacific coast, was sounded from within the livestock industry itself nearly three-quarters of a century ago.

Even when recognized, damage has frequently been tolerated by private owners because of economic pressure, including such policies as the deliberate holding over of excess numbers of animals for another year because of poor markets; taking a chance on a little



range damage in order to save money on costly feed; and pushing herds onto mountain ranges too early in the spring before the range was ready for grazing. Locally, many national-forest range areas likewise have suffered through attempts to relieve temporarily the strain on the local stockmen and local communities, in response to strong pressure during emergency periods of feed scarcity; and from the added strain of increasing livestock in an effort to increase meat production in 1918.

Finally, in a review of the reasons underlying past range practices, one must keep in mind that the pioneer stockman was forced to improvise untried rules. Previous husbandry—developed in eastern agriculture on comparatively small areas, with more uniform forage types, and more gentle stock under fenced control—fell flat when it came to handling sheep in bands as large as 3,000 head (98); tens of thousands of cattle in single ownership, and in at least one instance the almost incredible total of 150,000 head (118). Both classes of stock had to be handled over ranges extending from the smooth to the inaccessibly rough and from sea level to elevations above 12,000 feet, characterized by wide extremes of climate, and supporting hundreds of strange forage plants. New complex situations had to be met, and promptly. Rule-of-thumb methods quite naturally were resorted to by stockmen, and to some extent have been retained by public-land administrators in the absence of sufficient proved facts.

Even had more tested experimental results been available, a lag in their application was perhaps inevitable, especially on the part of the pioneer who, in the main, was the sturdy confident type that pushed back frontiers. One must keep in mind that the isolation, uncertainties, and emergencies of those times fostered reliance on independent judgment by early ranchmen, naturally a highly independent class who preferred opinion or practical experience to outside counsel regarding the conduct of their business. Consequently, within the industry itself there has not been any general appreciation of the value of tested information in meeting the changing western conditions. From this viewpoint the grazing industry stands in sharp contrast to farming with its sustained emphasis on research as a highly useful adjunct to practical management. Thus the lag in range research also may be regarded as one of the major reasons for the long-continued use of many rule-of-thumb practices. Because of its importance it is discussed in a separate section of this report.

